TephraProb: a user-friendly toolbox for the hazard assessment of ground tephra accumulation

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We present a toolbox designed to assist each step of the compilation of comprehensive hazard assessments for ground tephra accumulation using the advection-diffusion model TEPHRA2. This operating system-independent toolbox is displayed in the shape of graphical interfaces. Written in Matlab, a standalone-compiled version based on free libraries is also available. Key features of this toolbox are (i) modules to generate and collect necessary input data (i.e. calculation grid, wind data, eruptive history), (ii) modules to process grainsize data (i.e. total distribution, aggregation model), (iii) modules assisting the identification of eruptive scenarios based on the Global Volcanism Program in case limited field data is available, (iv) modules to statistically analyse wind profiles inferred from the NOAA NCEP/NCAR Reanalysis database, (v) modules to run the model in a range of fully deterministic to fully stochastic scenarios on single processors and cluster of computers, (vi) modules to process and display output data (i.e. probability maps for a given tephra threshold, isomass maps for a given probability of occurrence, hazard curves) and (vii) modules to export hazard maps (i.e. ArcGIS, Google Earth).

This toolbox allows for the assessment of the probability distribution of reaching a given tephra accumulation around a volcano using the following scenarios: One Eruption Scenario (OES) based on the statistical distribution of wind profiles, with all eruptive parameters determined deterministically; Eruption Range Scenario (ERS) based on the statistical distribution of both wind profiles and eruptive parameters, where a different set of eruptive parameters (i.e. erupted mass, plume height, grainsize distribution) is stochastically sampled within a user-defined range at each run of the model; One Wind Scenario (OWS) based on the statistical distribution of eruptive parameters within user-defined ranges, where one wind profile is deterministically chosen; Multiple Eruptions Scenario (MES) combines multiples OES, ERS or OWS to assess the accumulation of tephra from multiple eruptions in a given time period; Long-Lasting Eruption Scenario (LLES) assesses the accumulation of tephra from long-lasting eruptions by discretising length of the eruption into short pulses and by scaling mass eruption rates and erupted mass to the plume height of each pulse.

This new toolbox facilitates each step of the compilation of probabilistic hazard assessments for tephra fallout, from the gathering of input parameters from disparate sources to the post-processing of the output data. Additional modules for the processing of input parameters help the user to define the best scenario to adopt on a case per case basis (i.e. seasonal assessments, elaboration of scenarios with variable availability of field data, different eruptive styles). This toolbox is therefore an operative tool that can be used to rapidly produce comprehensive hazard assessments for tephra fallout.